D3

rotation at the shoulder and the rotation of the end effector about the wrist being in concert so that the substrate is moved into and out of the substrate holding area along an axis of translation from a number of generally parallel axes of translation straddling the axis of rotation at the shoulder.

REMARKS

This is in response to the Office Action mailed 12/19/00 (Paper no. 11). Claims 1, 5, and 28-29 have been amended above. Claims 1-29 remain pending in this application.

The Examiner has objected to Claim 5. Claim 5 has been amended to overcome the Examiner's objection. In addition, on line 14, "radial displacement" was substituted for the word "movement". Radial displacement of the end effector is equivalent to movement of the end effector, and thus the substitution does not narrow the claim in any way. Also, this substitution was performed to be consistent with the other sections of the claim which refer to radial displacement of the end effector. Claim 5 was further amended to replace "into" with the equivalent word "to", and "out of" with equivalent word "from". Claim 28 was also similarly amended. These amendments were made to clarify the portion of the translation axis referred to in the Claims and not to narrow the Claims in any way.

Claims 1-4, 24-26 and 29 have been rejected under 35 U.S.C. 112, First paragraph as containing subject matter which is not described in the Specification. The Applicant disagrees. The Examiner's attention is directed to page

12, lines 6-16, of the Specification, which state that "to achieve the compound "R" and "T" movement of the movable arm assembly 25, the drive shafts 46, 48 are rotated at dissimilar rates." In other words, when the arm is undergoing "R" movement (rotation) the first shaft is rotating, and when the arm is undergoing "T" movement (extension) the second shaft is rotating. Claims 1, and 29 (before amendment) recited that the first drive shaft is rotated to effect rotation, and the second shaft is rotated to effect extension of the arm. As described in the Specification, rotation of the arm cannot be effected without rotating the first shaft, and extension cannot be effected without rotation the second shaft. The aforementioned features recited in Claims 1, and 29 are clearly described, albeit not word for word, in the instant Specification. Nevertheless, in order to expedite allowance of this Application, filed 9/30/98, and clearly not for reasons related to patentability, the language in Claims 1, and 29 has been amended to eliminate this issue.

Claim 5 was rejected under 35 U.S.C. 102 as being anticipated by Fukasawa. The Applicant respectfully disagrees.

Claim 5 calls for the initial and final position of the end effector being connected by an axis of translation which is one of two generally parallel axes of translation (of the end effector); wherein

> -radial displacement of the end effector <u>complements</u> rotation of the transport arm (as a unit) to result in the substrate being translated along the axis of translation.

Fukasawa does not anticipate the features of claim 5. The Applicant has addressed Fukasawa in the previous response mailed 09/25/2000 (the arguments of which are repeated again herein). It appears that, inside each of the cassette chambers 3a, 3b or the vacuum processing chambers 4a, 4b the substrate indeed travels in a straight line (to move between the walls of the cassette as suggested by the Examiner). However, Fukasawa makes no mention of the initial position (which is clearly outside and not between the walls of the cassette) of the end effector, nor of whether the initial and final positions of the end effector are connected by an axis of translation which is one of two generally parallel axes of translation as called for in claim 5. The applicant is not ignoring common sense, but is merely noting that (other than relying on the Applicant's own disclosure) the Examiner relies on no other reference which discloses that the initial and final positions of the end effector (one of which must clearly be outside the cassette) are connected by an axis of translation which is one of two generally parallel axes of translation as called for in claim 5. In Fukasawa, once the substrate is out of the cassette 3a, 3b, the end effector may move along any number of convey paths (see col. 10, lines 41-43; the convey path for a wafer W conveyed by convey arms 51 to 53 can be freely selected within the stroke range of each arm).

In addition, nowhere does Fukasawa make any mention that the radial displacement of the end effector (convey arm 53) relative to the axis of rotation of the transport arm has any particular relation to the rotation of the transport arm as a unit about the axis of rotation. On the contrary, in Col. 10, lines 41-43, Fukasawa discloses that the

movements of each convey arm 51-53 can be freely selected within the stroke range of each arm 51-53. Thus, arguably, even if the wafer W in Fukasawa is transported along an axis of translation (though the Applicant maintains that Fukasawa does not disclose this), this is not necessarily the result of the end effector (arm 53) being radially displaced relative to shaft 61 (the axis of rotation of multi-joint arm 5 as a unit) to complement the rotation of the multi-joint arm 5 as a unit. For example, wafer W may be moved along an axis by independently pivoting convey arms 53, 52 respectively about shafts 53a (the wrist), and 52a (the elbow). In this case, the multi-joint arm 5 itself need not be rotated as a unit about shaft 61a (as is otherwise called for in claim 5). Thus, Fukasawa simply does not disclose that the radial displacement of the end effector complements rotation of the transport arm as a unit to result in the substrate being translated along the axis of translation connecting the initial and final position of the end effector as is called for in claim 5. Claims 5 and 27 read over the cited prior art and should be allowed.

Claims 1-4, 26 and 29 have been rejected under 35 U.S.C. 103 as being unpatentable over Fukasawa in view of Carlisle. The Applicant respectfully disagrees.

Claim 1 calls for rotating the two drive shafts to effect rotation of the transport arm (which rotates the wrist about the shoulder) and to effect extension of the transport arm (which radially displaces the wrist relative to the shoulder), wherein radial displacement of the wrist causes rotation of the end effector about the wrist to;

- rotate the substrate (on the end effector) about the shoulder in concert with

- rotation of the wrist about the shoulder, so that;

- the substrate is moved along one of a number of parallel axes.

Neither Fukasawa, nor Carlisle disclose or suggest the features called for in Claim 1. The multi-joint arm member 5 in Fukasawa uses three drive shafts (not two) to rotate the arm member 5, to radially displace the wrist, and to rotate the end effector about the wrist (see Fig. 4, col. 6, lines 49-51). Rotation, and extension of the multi-joint arm 5 to radially displace the wrist (i.e. shaft 53a) relative to the shoulder (i.e. shaft 61a) is accomplished by rotating shaft 61a and shaft 52a. However, this does not cause rotation of upper convey arm 53 about the wrist (shaft 53a). To rotate the upper convey arm 53 about the wrist in Fukasawa, the third drive shaft 53a is rotated. Hence, Fukasawa discloses rotating three (not two) drive shafts to rotate the transport arm, to extend the arm and radially displace the wrist from the shoulder, and to rotate the end effector about the wrist.

Moreover, nowhere does Fukasawa disclose or suggest that the rotation of the end effector (upper convey arm 53) about the wrist is such as to rotate a substrate (on convey arm 53) about the shoulder in concert with rotation of the wrist about the shoulder so that the substrate is moved along as otherwise called for in claim 1. In other words, in claim 1 the rotation of the substrate about the shoulder in concert with the rotation of the wrist about the shoulder moves the substrate along the translation axis.

Also, the rotation of the wrist about the shoulder is effected by rotating the transport arm about the shoulder (and all this is being accomplished with only two drive shafts). Thus, according to the invention recited in claim 1, the substrate is moved along one of a number of parallel axes by:

1. rotating the transport arm which rotates the wrist about the shoulder;

2. rotating the substrate about the shoulder by extending the arm; and

3. the rotation of the wrist and the rotation of the substrate being in concert such that the substrate travels along a straight line.

Nothing like this is disclosed or suggested in Fukasawa. As noted before, Fukasawa discloses merely that the independently movable convey arms 51-53 allow the convey path of a wafer to be freely selected. Fukasawa however makes no mention as to how the convey arms 51-53 are moved to convey wafer W along any path, or along a straight path such as when the wafer is inside the cassette. As noted before, in Fukasawa the wafer may be conveyed along a straight line inside the cassette without rotating the multi-joint arm 5 about the shoulder (shaft 61a). Clearly, Fukasawa does not disclose or suggest the features called for in Claim 1.

Carlisle discloses an articulated robotic manipulator with two arms 18, 20 and a quill 110 which carries an end effector (col. 5, lines 20-24). The manipulator is mounted on base 10 which includes two coaxially aligned motors 12,

14 powering two co-axial shafts 40 and 56 to drive both arms 18 (rotation J1) and 20 (rotation J2) (see Figs. 1 & 3, col. 3, lines 63-69). Nowhere does Carlisle disclose or suggest that extension of the two arms 18, 20 alone causes rotation of the end effector about the wrist (rotation J4).

In addition, the Carlisle manipulator has another drive motor 100 (i.e. a third drive shaft) to drive (via belt 106 and pulley 104) the quill 110 which carries the end effector (rotation J4) (Figs. 6-7, col. 5, lines 22-24). Carlisle discloses that the third drive is used to drive the quill vertically along axis J3 (by rotating the drive 120 over non-rotating quill 110). Otherwise, in col. 4, lines 7-10, Carlisle discloses that the third drive shaft 100 (see Fig. 6-7) can also be used to rotate the end effector on quill 10 (rotation J4) about the wrist. Thus, clearly, Carlisle discloses rotating all three drive shafts (similar to Fukasawa) to effect rotation of the arm, extension of the arm, and rotation of the end effector about the wrist. Nowhere does Carlisle disclose or suggest rotating two drive shafts to effect rotation of the transport arm, and to effect extension of the arm which radially displaces the wrist, wherein extension of the arm causes rotation of the end effector about the wrist as otherwise called for in claim 1. Moreover Carlisle says nothing about how the articulated manipulator moves a substrate into and out of a substrate holding area as called for in Claim 1. Fukasawa and Carlisle disclose substantially similar drives (i.e. using three drive shafts to articulate the arm) and neither disclose or suggest the features called for in claim 1. Accordingly, the combination of Fukasawa and Carlisle clearly cannot provide features which are not disclosed or suggested in either

reference. Claims 1-4 and 26 are patentable over the cited prior art and should be allowed.

Claim 29 calls for rotating two drive shafts to effect rotation of the arm, and extension of the arm which causes the end effector to rotate about the wrist (similar to claim 1), wherein:

- rotation of the arm about the shoulder, and
- radial displacement of the wrist from the shoulder, and
- rotation of the end effector about the wrist are all in concert so that the substrate moves along one of a number of parallel axes straddling the shoulder.

It is not seen where either Fukasawa, or Carlisle disclose or suggest anything about the relationship between the rotation of the arm, the radial displacement of the wrist, and rotation of the end effector to move a substrate along an axis of translation. Moreover, as noted before in regards to claim 1, both Fukasawa and Carlisle have a three shaft drive systems, not two shaft systems as called for in claim 29. Claim 29 is patentable over the cited prior art and should be allowed.

Claims 8-16, and 28 have been rejected under 35 U.S.C. 103 as being unpatentable over Bacchi in view of Ohta. The Applicant respectfully disagrees.

Claim 8 calls for three side by side holding areas which are aligned with each other along one side of the drive section.

As noted in Applicant's previous response mailed 09/25/2000, neither Bacchi nor Ohta disclose the features recited in claim 8. Bacchi discloses only two side by side cassettes 168L and 168R. Ohta discloses arranging cassettes in an arc. Neither discloses or suggest three holding areas aligned with each other along one side of the drive section. The Examiner appears to agree with this, because on page 4, paragraph 12 of the action, the Examiner states that Claim 8 would otherwise be patentable if it called for the holding areas to be in a straight line. Having three side by side holding areas which are aligned with each other on one side of the drive, as recited in claim 8, is the same as the holding areas being a straight line, as suggested by the Examiner. Thus, claims 8-16 are clearly patentable over the cited prior art and should be allowed.

Claim 28 calls for transporting substrates along generally parallel axes of translation straddling the drive section towards and away from two side by side substrate holding areas along a side of the processing apparatus. Nowhere is this disclosed or suggested in Bacchi, or Ohta. Fig. 6A, in Bacchi shows one axis of translation (the left axis to cassette 168L) extends through the shoulder pivot of the arm. Thus, as can be seen in Fig. 6A, the axes of translation in Bacchi clearly do not straddle the drive section of the arm as called for in claim 28. The cassettes in Ohta are in an arc, and hence, the axes of translation are converging/diverging, but clearly not parallel as called for in claim 28. Neither Bacchi, nor Ohta disclose or suggest the features called for in claim 28, and the combination of Bacchi and Ohta cannot provide features which are not disclosed or suggested in either

reference. Claim 28 is patentable over the cited prior art and should be allowed.

Enclosed is a check in the amount of $110.00 as payment for the fee for a petition for a one-month extension of time. Please charge deposit account 16-1350 for any fee deficiencies arising from the filing of this Amendment.

For all of the foregoing reasons, it is respectfully submitted that all of the claims now present are clearly novel and patentable over the prior art of record. Accordingly, favorable reconsideration and allowance is respectfully requested. Should any unresolved issue remain, the Examiner is invited to call Applicant's Attorney at the telephone number indicated below.

Respectfully submitted,

J. M — 4/3/01

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APPENDED SHEETS

MARKED-UP CLAIMS:

1. (Twice Amended) A method for transporting a substrate into and out of a substrate holding area on a substrate processing apparatus comprising the steps of:

providing the substrate processing apparatus with a transport arm connected to a drive section with two drive shafts;

providing the substrate on an end effector of the transport arm, the end effector being rotatably mounted to a wrist of the transport arm; and

rotating [a first of] the two drive shafts to effect rotation of the transport arm about an axis of rotation at a shoulder of the transport arm [and rotate] for rotating the wrist about the axis of rotation [;] , and

[rotating a second of the two drive shafts] to effect extension of the transport arm [and] for radially [displace] displacing the wrist of the transport arm relative to the axis of rotation at the shoulder of the transport arm, wherein the extension of the transport arm to radially displace the wrist causes rotation of the end effector about the wrist to rotate the substrate about the axis of rotation at the shoulder of the transport arm in concert with rotation of the wrist about the axis of rotation at the shoulder

of the transport arm so that the substrate is moved along one of a number of generally parallel axes of translation straddling the drive section.

5. (Twice Amended) A method for transporting a substrate into and out of a substrate holding area comprising the steps of:

providing the substrate on an end effector of a transport arm;

rotating the transport arm as a unit about an axis of rotation; and

moving the end effector of the transport arm to radially displace the end effector relative to the axis of rotation, the end effector being moved from an initial position to a final position, the initial and final positions of the end effector being connected by an axis of translation of the end effector;

wherein the [movement] radial displacement of the end effector complements the rotation of the transport arm about the axis of rotation to result in the substrate being substantially rectilinearly translated along the axis of translation [into] to and [out of] from the substrate holding area, the axis of translation being one of two generally parallel [axis] axes of translation on opposite sides of the drive section.

28. (Amended) A substrate transport apparatus comprising:

a drive section with a first drive shaft, and a second drive shaft;

a robot transport arm mounted to the drive section, the robot transport arm including an upper arm, a forearm pivotably connected to the upper arm to pivot about an elbow of the upper arm, and an end effector pivotably connected to the forearm to pivot about a wrist of the forearm, the upper arm being connected to the first drive shaft so that the upper arm is rotated about the drive section when the first drive shaft is rotated, the elbow being connected to the second drive shaft so that the forearm is rotated about the elbow when the second drive shaft is rotated, the end effector being slaved to the forearm so that when the forearm rotates about the elbow the end effector rotates about the wrist;

wherein the robot transport arm is adapted to transport substrates with the end effector along generally parallel axes of translation straddling the drive section [into] <u>to</u> and [out of] <u>from</u> two side by side substrate holding areas disposed along a side of a substrate processing apparatus with the drive section being located in only one location relative to the substrate processing apparatus.

29. (Amended) A method for transporting a substrate into and out of a substrate holding area on a substrate processing apparatus comprising the steps of:

providing the substrate processing apparatus with a transport arm connected to a drive section having two drive shafts;

providing the substrate on an end effector of the transport arm, the end effector being rotatably mounted to a wrist of the transport arm; and

rotating [a first of] the two drive shafts to effect rotation of the transport arm about an axis of rotation at a shoulder of the transport arm [and rotate] for rotating the wrist about the axis of rotation [;] , and

[rotating a second of the two drive shafts] to effect extension of the transport arm to radially displace the wrist of the transport arm relative to the axis of rotation at the shoulder of the transport arm, wherein the extension of the transport arm when the second drive shaft is rotated effects rotation of the end effector about the wrist, the rotation of the transport arm about the axis of rotation at the shoulder, the extension of the transport arm to radially displace the wrist relative to the axis of rotation at the shoulder and the rotation of the end effector about the wrist being in concert so that the substrate is moved into and out of the substrate holding area along an axis of translation from a number of generally parallel axes of translation straddling the axis of rotation at the shoulder.